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EXAMINER	
LERNER, MARTIN	
ART UNIT	**PAPER NUMBER**
2654	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	10/036,747	KLEIJN, W. BASTIAAN
	Examiner	Art Unit
	Martin Lerner	2654

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 03 November 2005.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1, 2, 4, 6 to 14, 16, 18 to 25, 27, 28, and 30 to 38 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1, 2, 4, 6 to 14, 16, 18 to 25, 27, 28, and 30 to 38 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1 to 2, 7 to 8, 10, 12 to 14, 20, 22 to 25, and 30 to 38 are rejected under 35 U.S.C. 102(e) as being anticipated by *Gustafsson et al.*

Regarding independent claim 1, *Gustafsson et al.* discloses a method of signal noise reduction by spectral subtraction, comprising:

"receiving a distorted input signal that includes an embedded corrupting signal, wherein the embedded corrupting signal is statistically related to the undistorted sound signal" – a noise speech signal, *x(n)*, is received, and transformed into an N length Fourier transform signal, X_N (column 3, lines 33 to 59: Figures 3, 4 and 6); statistical properties of the signal are properties of the input signal, and not of the invention *per se*; implicitly, there are generally components of the noise that are related to the signal, as admitted by the Specification, Page 4, Lines 25 to 34;

"defining an enhancement signal as a difference between the distorted input signal and the enhanced output signal, whereby the enhancement signal attempts to offset the embedded corrupting signal" – a clean speech Fourier transform is estimated by a term $|W_N(f_u)|$, representing noise in a noisy speech signal; noise term $|W_N(f_u)|$ ("an enhancement signal") is a difference between a term representing a noisy speech signal $|X_N(f_u)|$ ("a distorted input signal") and a term representing a clean speech signal $|S_N(f_u)|$ ("an enhanced output signal") for spectral subtraction (column 4, lines 1 to 19: Figures 3, 4, and 6: Equations (7) and (8));

"determining a power of the enhancement signal" – gain function G_N represents power of noise term $|W_N(f_u)|$ (column 4, lines 29 to 48: Figures 3, 4, and 6: Equation (12)); a spectral subtraction algorithm involves a parameter a, where setting a = 2 provides power spectral subtraction (column 5, lines 10 to 19); generally, squaring a value $|W_N(f_u)|$ produces a power of a value;

"constraining possible values for the power of the enhancement signal based on characteristics of the distorted input signal" – a spectral subtraction algorithm involves a parameter k, which controls an amount of noise subtraction and speech quality; k is adjusted so that the desired noise reduction is achieved; if a larger k is chosen, the speech distortion increases; it is common to use oversubtraction for k > 1 (column 5, lines 10 to 27); a power of a noise term $|W_N(f_u)|$ is obtained by scaling with a parameter k (column 4, lines 11 to 48: Equations (9) and (12)); thus, a value for k is chosen for "constraining possible values for the power of the enhancement signal"; implicitly, k is chosen "based on characteristics of the distorted input signal" because k is adjusted to

obtain a desired noise reduction; a parameter k can depend upon a signal-to-noise ratio of a noisy signal ("based on characteristics of the distorted input signal") (column 13, lines 11 to 11 to 30);

"producing the enhanced output signal, based at least in part upon constrained values of the power of the enhancement signal resulting from the constraining step" – a clean speech signal $|S_N(f_u)|$ ("an enhanced output signal") is obtained by spectral subtraction after subtracting noise term $|W_N(f_u)|$ scaled with a parameter k, or equivalently, applying gain function G_N (column 4, lines 11 to 48: Equations (9) and (12)).

Regarding independent claim 13, *Gustafsson et al.* discloses a method of signal noise reduction by spectral subtraction, comprising:

"receiving a distorted input signal that includes an embedded corrupting signal, wherein the embedded corrupting signal is statistically related to the undistorted sound signal" – a noise speech signal, $x(n)$, is received, and transformed into an N length Fourier transform signal, X_N (column 3, lines 33 to 59: Figures 3, 4 and 6); statistical properties of the signal are properties of the input signal, and not of the invention *per se*; implicitly, there are generally components of the noise that are related to the signal, as admitted by the Specification, Page 4, Lines 25 to 34;

"estimating a first iteration enhanced output signal" – a clean speech signal $|S_N(f_u)|$ ("a first iteration enhanced output signal") is obtained by spectral subtraction (column 4, lines 1 to 19: Figures 3, 4, and 6: Equations (7) and (8));

"defining a first iteration enhancement signal as a difference between the distorted input signal and the first iteration enhanced output signal" – a clean speech Fourier transform is estimated by a term $|W_N(f_u)|$, representing noise in a noisy speech signal; noise term $|W_N(f_u)|$ ("a first iteration enhancement signal") is a difference between a term representing a noisy speech signal $|X_N(f_u)|$ ("a distorted input signal") and a term representing a clean speech signal $|S_N(f_u)|$ ("a first iteration enhanced output signal") for spectral subtraction (column 4, lines 1 to 19: Figures 3, 4, and 6: Equations (7) and (8));

"determining a power of the first iteration enhancement signal" – gain function G_N represents power of noise term $|W_N(f_u)|$ (column 4, lines 29 to 48: Figures 3, 4, and 6: Equation (12)); a spectral subtraction algorithm involves a parameter a, where setting a = 2 provides power spectral subtraction (column 5, lines 10 to 19); generally, squaring a value $|W_N(f_u)|$ produces a power of a value;

"constraining possible values for the power of the first iteration enhancement signal based on characteristics of the distorted input signal" – a spectral subtraction algorithm involves a parameter k, which controls an amount of noise subtraction and speech quality; k is adjusted so that the desired noise reduction is achieved; if a larger k is chosen, the speech distortion increases; it is common to use oversubtraction for k > 1 (column 5, lines 10 to 27); a power of a noise term $|W_N(f_u)|$ is obtained by scaling with a parameter k (column 4, lines 11 to 48: Equations (9) and (12)); thus, a value for k is chosen for "constraining possible values for the power of the first iteration enhancement signal"; implicitly, k is chosen "based on characteristics of the distorted input signal"

because k is adjusted to obtain a desired noise reduction; a parameter k can depend upon a signal-to-noise ratio of a noisy signal ("based on characteristics of the distorted input signal") (column 13, lines 11 to 11 to 30);

"producing a second iteration enhanced output signal, based at least in part upon constrained values of the power of the first enhancement signal resulting from the constraining step" – a clean speech signal $|S_N(f_u)|$ ("a second iteration enhanced output signal") is obtained by spectral subtraction after subtracting noise term $|W_N(f_u)|$ scaled with a parameter k, or equivalently, applying gain function G_N (column 4, lines 11 to 48: Equations (9) and (12)); an iteration of an enhanced output signal is obtained ("a second iteration enhanced output signal") by feeding back a result of spectral subtraction between a first spectral subtraction stage 601 and a second spectral subtraction stage 602, and onto a third spectral subtraction stage 603 (column 12, line 54 to column 13, line 30: Figure 6).

Regarding independent claim 24, *Gustafsson et al.* discloses an apparatus for signal noise reduction by spectral subtraction, comprising:

"an enhancement circuit that receives the distorted input signal and produces a first iteration enhanced output signal, wherein the enhancement circuit defines the first iteration enhancement signal as a difference between the enhanced output signal and the distorted input signal" – a clean speech Fourier transform is estimated by a term $|W_N(f_u)|$, representing noise in a noisy speech signal; noise term $|W_N(f_u)|$ ("a first iteration enhancement signal") is a difference between a term representing a noisy speech signal

$|X_N(f_u)|$ ("a distorted input signal") and a term representing a clean speech signal $|S_N(f_u)|$ ("a first iteration enhanced output signal") for spectral subtraction (column 4, lines 1 to 19: Figures 3, 4, and 6: Equations (7) and (8));

"determines a power of the first iteration enhancement signal" – gain function G_N represents power of noise term $|W_N(f_u)|$ (column 4, lines 29 to 48: Figures 3, 4, and 6: Equation (12)); a spectral subtraction algorithm involves a parameter a, where setting a = 2 provides power spectral subtraction (column 5, lines 10 to 19); generally, squaring a value $|W_N(f_u)|$ produces a power of a value;

"constrains possible values for the power of the first iteration enhancement signal based on characteristics of the distorted input signal" – a spectral subtraction algorithm involves a parameter k, which controls an amount of noise subtraction and speech quality; k is adjusted so that the desired noise reduction is achieved; if a larger k is chosen, the speech distortion increases; it is common to use oversubtraction for k > 1, (column 5, lines 10 to 27); a power of a noise term $|W_N(f_u)|$ is obtained by scaling with a parameter k (column 4, lines 11 to 48: Equations (9) and (12)); thus, a value for k is chosen so that it "constrains possible values for the power of the first iteration enhancement signal"; implicitly, k is chosen "based on characteristics of the distorted input signal" because k is adjusted to obtain a desired noise reduction; a parameter k can depend upon a signal-to-noise ratio of a noisy signal ("based on characteristics of the distorted input signal") (column 13, lines 11 to 11 to 30);

"a feedback circuit that feeds back the first iteration enhancement signal as an improved distorted input signal to effect production of a second iteration enhanced

output signal by the enhancement circuit" – an iteration of an enhanced output signal is obtained ("a second iteration enhanced output signal") by feeding back a result of spectral subtraction between a first spectral subtraction stage 601 and a second spectral subtraction stage 602, and onto a third spectral subtraction stage 603 (column 12, line 54 to column 13, line 30: Figure 6).

"an output circuit that produces the enhanced output signal upon completion of at least one iteration cycle" — a clean speech signal $|S_N(f_u)|$ ("an enhanced output signal") is obtained by spectral subtraction after subtracting noise term $|W_N(f_u)|$ scaled with a parameter k, or equivalently, applying gain function G_N (column 4, lines 11 to 48: Equations (9) and (12)); an estimate of clean speech, or noise reduced speech, $Y_s(f, i)$ is output by third spectral subtraction stage 603 (column 12, line 54 to column 13, line 10: Figure 6).

Regarding claims 2, 14, and 25, *Gustafsson et al.* discloses samples are taken over an N length Fourier transform (column 3, lines 54 to 65: Figures 3, 4, and 6); a length of N samples defines a window for a signal ("a finite-support window").

Regarding claims 7 and 8, *Gustafsson et al.* discloses an iteration of an enhanced output signal is obtained ("a second iteration enhanced output signal") by feeding back a result of spectral subtraction between a first spectral subtraction stage 601 and a second spectral subtraction stage 602, and onto a third spectral subtraction stage 603 (column 12, line 54 to column 13, line 30: Figure 6); spectral subtraction between a first spectral subtraction stage 601 and a second spectral subtraction stage

602, and onto a third spectral subtraction stage 603 involves "additional defining, determining, constraining, and producing steps to iteratively refine the enhanced output signal."

Regarding claims 10 and 20, *Gustafsson et al.* discloses noise is estimated from a previous frame $Y_n(f, i-1)$ (column 12, lines 54 to 56); thus, previous frame samples ("backward-in-time sample-sequences") are used to determine a clean speech signal; there are L samples in a frame (column 11, lines 48 to 65).

Regarding claims 12 and 23, *Gustafsson et al.* discloses a method for signal noise reduction by spectral subtraction where calculations are performed as instructions on a processor.

Regarding claim 22, *Gustafsson et al.* discloses spectral subtraction between a first spectral subtraction stage 601 and a second spectral subtraction stage 602, and onto a third spectral subtraction stage 603 operates on a same frame i for $Y_r(f, i)$, $Y_n(f, i)$, and $Y_s(f, i)$ (column 12, line 54 to column 13, line 10: Figure 6).

Regarding claims 30, 32, 33, 35, 36, and 38, *Gustafsson et al.* discloses spectral subtraction for speech enhancement (Abstract).

Regarding claims 31, 34, and 37, *Gustafsson et al.* discloses k is chosen so that $1 - k|W_N|^2/|X_N|^2 > 0$, or $1 > k|W_N|^2/|X_N|^2$, or $|X_N|^2 > k|W_N|^2$ (column 4, lines 29 to 48: Equation (12)); thus, k is generally a fraction less than but arbitrarily close to unity, unless over-subtraction ($k > 1$) is used (column 5, lines 10 to 27); the power of the enhancement signal, $k|W_N|^2$ is less than a power of a distorted input signal $|X_N|^2$, so it follows that k is chosen so that $k|W_N|^2$ is a certain fraction, *i.e.* between 0 and 1, of $|X_N|^2$.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 4, 6, 11, 16, 18, 21, 27, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Gustafsson et al.* in view of *Ozawa*.

Concerning claims 4, 6, 16, 18, and 27, *Gustafsson et al.* omits increasing a periodicity of a distorted input signal. However, it is known to add a pitch filter for encoding speech to increase its periodicity. *Ozawa* discloses optionally adding a pitch postfilter. (Column 7, Lines 32 to 39). A pitch postfilter increases a pitch component of an output signal, or increases the periodicity. The objective is to provide a signal with improved tone quality. (Column 1, Lines 19 to 25) It would have been obvious to one having ordinary skill in the art to increase periodicity of a distorted input signal with a pitch filter as taught by *Ozawa* in a method and apparatus for signal noise reduction by spectral subtraction of *Gustafsson et al.* for the purpose of improving tone quality.

Concerning claims 11, 21, and 28, *Ozawa* discloses noise is quantization noise, which is produced by encoding a voice signal ("an artifact of encoding and decoding") (column 1, lines 14 to 25).

5. Claims 9 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Gustafsson et al.* in view of *Bialik et al.*

Gustafsson et al. does not expressly disclose forward-in-time samples. However, *Bialik et al.* teaches a pitch postfilter, where samples are taken from present frame buffer 25 and prior frame buffer 26. Data can be taken from previous subframes 20d, 20c, and 20b, and from future subframes 20e, 20f, and 20g. (Column 2, Line 65 to Column 3, Line 11: Figure 2) The objective is to provide a pitch postfilter that utilizes future and past information for at least some of the subframes to improve performance. (Column 1, Lines 31 to 49) It would have been obvious to one having ordinary skill in the art to take both backward-in-time sample-sequences and forward-in-time sample-sequences as taught by *Bialik et al.* in the postfiltering method of *Ozawa* for the purpose of providing better performance by utilizing future and past information for a pitch postfilter.

Response to Arguments

6. Applicant's arguments file 03 November 2005 have been considered but are moot in view of the new grounds of rejection.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to Applicant's disclosure.

Takagi, Lockwood et al. ('489), Lockwood et al. ('650), and Fang et al. disclose related art.

Wikipedia provides a definition of "impulse response".

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Martin Lerner whose telephone number is (571) 272-7608. The examiner can normally be reached on 8:30 AM to 6:00 PM Monday to Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Richemond Dorvil can be reached on (571) 272-7602. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Martin Lerner
Examiner
Group Art Unit 2654